(12) UK Patent Application (19) GB (11) 2 142 559 A

(43) Application published 23 Jan 1985

(21) Application No 8415369

(22) Date of filing 15 Jun 1984

(30) Priority data

(31) 508881 (32) 29 Jun 1983 (33) US

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(51) INT CL³
B05B 5.02

(52) Domestic classification
B2F 332 GB
H2A KS
U1S 1888 B2F H2A

(56) Documents cited
GB 1597349
GB 0471865
EP A1 0052952

(58) Field of search
B2F
H2A

(54) Electrostatic spray gun

(57) An electrostatic spray gun comprises an internal air turbine (48) mechanically linked to a rotatable electrical generator (50), an air coupler (28) attached to the spray gun for receiving pressurised air, electric circuitry (52) coupled to the generator for developing high voltage in response to the pressurised air delivered to the turbine, and an internal passage (30, 42) passing between the air coupler and the turbine with an exhaust chamber (54) at least partially surrounding the generator and the circuitry to cool these components and coupled in air flow connection to the turbine. An exhaust passage (60) is connected to the exhaust chamber and opens to the exterior. An externally actuable air valve (34) opens and closes the internal passage (30,42) and an air flow regulator (44) controls air flow therethrough.

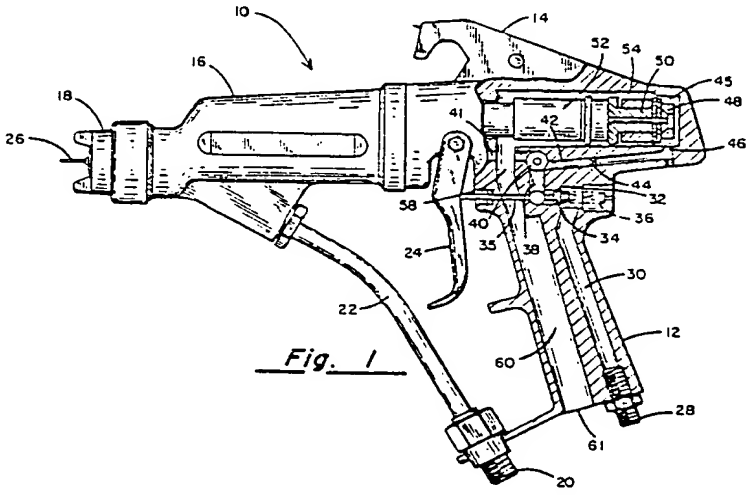

Fig. 1

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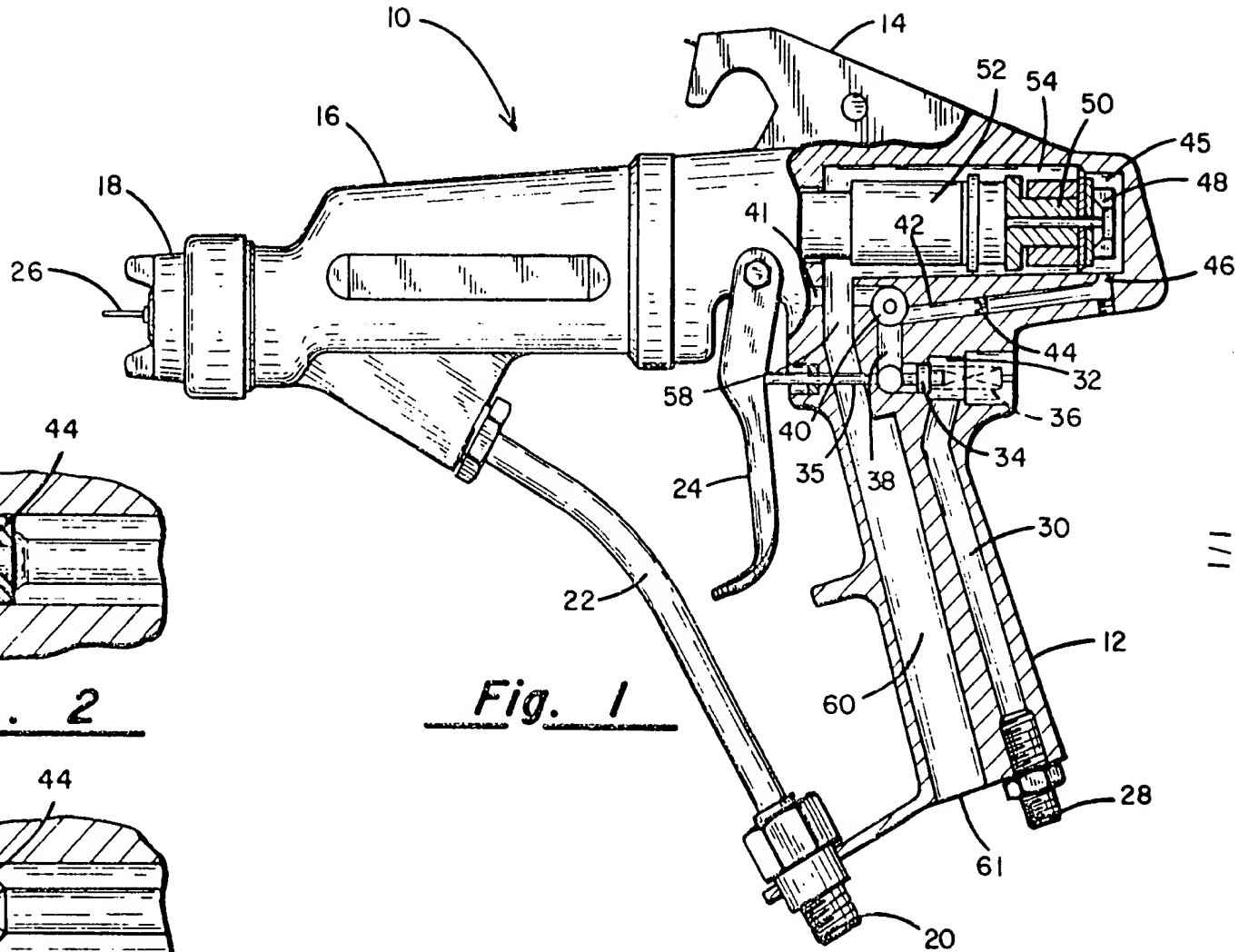

Fig. 1

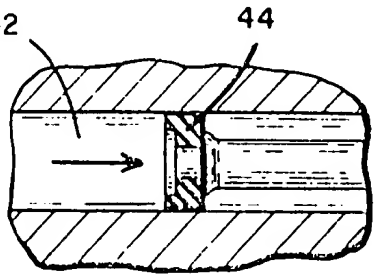

Fig. 2

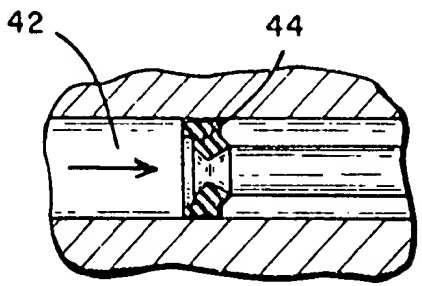

Fig. 3

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SPECIFICATION

Electrostatic spray gun

This invention relates to electrostatic spray guns, and more particularly to electrostatic spray guns having an internal air turbine mechanically linked to a rotatable electrical generator and electric circuitry coupled to the generator for developing high voltage in response to pressurised air delivered to the turbine.

The present invention seeks to provide an electrostatic spray gun where pressurised air is supplied for the purpose of driving the turbine, cooling components within the gun and exhausting the pressurised air with minimum noise.

The process of converting pressurised air input into high voltage results in certain energy losses which produce heat inside the body of the spray gun. The body is typically constructed of an electrically insulating plastics material, which is also a good heat insulator, and the internal heat generated by the mechanical and electrical components is not readily dissipated. Excessive heat build-up can damage or destroy the mechanical and electrical components therein, and therefore care must be taken in designing such spray guns to provide means for dissipating the heat. The problem of internal heat build-up is further complicated by the need to reduce the overall physical size of the spray gun so that it may be manufactured in a compact package for easy handling by an operator. It is also desirable to make the spray gun as light in weight as possible, all of which makes it difficult to design into the spray gun the appropriate metallic heat conductors which might otherwise draw heat away from the electrical components. The problem of removing excessive heat from such spray guns is addressed by the present invention, while at the same time controlling the air flow rate and minimising the audible noise caused by the exhaust of the pressurised air supply to the spray gun.

Although the present invention is primarily directed to any novel integer or step, or combination of integers or steps, herein disclosed and/or as shown in the accompanying drawings, nevertheless, according to one particular aspect of the present invention to which, however, the invention is in no way restricted, there is provided an electrostatic spray gun comprising: an internal air turbine mechanically linked to a rotatable electrical generator; an air coupler attached to said gun for receiving pressurised air; electric circuitry coupled to said generator for developing high voltage in response to the pressurised air delivered to the turbine; an internal passage passing between said air coupler and said turbine: an external actuable air valve in said passage for opening and closing said internal passage; an air flow regulator in said internal passage; an exhaust chamber at least partially surrounding said generator and said circuitry and coupled in air flow connection to said turbine; and an exhaust passage connected to said exhaust and opening to the exterior.

Preferably the spray gun includes a body having a handle and a barrel attached thereto, said air coupler being attached to said handle.

Said internal passage may includes a passageway through said handle, said air valve being located in the passageway.

Said turbine and generator are preferably contained in said body, said exhaust chamber comprising a cavity in said body substantially surrounding said turbine and said generator.

Said exhaust passage, in the preferred embodiment, includes a passageway through said handle, connected at one of its ends to said exhaust chamber and opening through the handle at its other end.

Preferably said air flow regulator comprises a resilient O-ring in said internal passage, said O-ring being deformable to constrict an opening therethrough under the influence of predetermined excess air pressure.

According to a further non-restrictive aspect of the present invention there is provided an electrostatic spray gun comprising: a barrel for emitting particles and having an electrode projecting therefrom; a handle; a body attached to said barrel and said handle, said body having a pivotal trigger attached thereto and enclosing an air turbine and electrical generator; an air connector attached to said handle and a first passage in said handle coupled to said air connector and extending into said body; a second passage in said body coupling between said first passage and said air turbine in air flow relationship; an air flow regulator in said second passage; a cavity in said body about said air turbine and said generator, said cavity being in air flow coupling relationship to said air turbine; a third passage coupled between said cavity and said handle, said third passage passing through said handle and opening to the exterior.

The spray gun may include a valve in said first passage having an actuator stem passing through said handle to an actuating position proximate said trigger.

Said air flow regulator may comprise a deformable resilient ring in said second passage.

In the preferred embodiment said first and third passages are substantially parallel over at least a portion of their respective lengths in said handle.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:-

Figure 1 shows an electrostatic spray gun according to the present invention in elevation and in partial cross-section;

Figure 2 is a cross-section of an air flow regulator of the spray gun of Figure 1; and

Figure 3 is a further cross-section of the air flow regulator of Figure 2.

Referring to Figure 1 there is shown a spray gun 10 according to the present invention having a handle 12 which is attached to a body 14, and a barrel 16 which is also attached to the body 14. The barrel 16 has attached proximate its front end a spray nozzle 18 which is adapted for emitting spray particles of liquid such as paint. Liquid is admitted into the spray gun 10 at a connector 20, and passes through a tube 22 which is connected to the barrel 16. Internal passages (not shown) convey the liquid into the

vicinity of the nozzle 18 where a spray valve is located for releasing the liquid into the atmosphere. The spray valve is controlled by actuation of a trigger 24 which is pivotally attached to the body 14. A high voltage potential is developed in the spray gun 10, and is conveyed via conductors to an electrode 26 which projects from the front of the nozzle 18. A source of pressurised air is connected to a connector 28, and is conveyed through passages inside of the spray gun to be hereinafter described.

A passage 30 passes through the handle 12 of the spray gun 10, in flow communication at one of its ends with the connector 28, and terminating at its other end in a chamber 32. The chamber 32 has therein an air valve 34 which is seated to block the flow of pressurised air from the chamber 32 to any further passages inside the spray gun. The air valve 34 is biased in its seated position by a compression spring 36 in the chamber 32. The air valve 34 is actuated by the trigger 24, to a valve stem 35 which enables the unseating of the air valve 34 against the spring 36. When the trigger 24 is squeezed the air valve 34 unseats from its blocking relationship to air passages in the spray gun, and pressurised air conveyed into a passage 38.

The passage 38 is coupled to a plenum 40, which diverts pressurised air in two directions, through a passage 41 and also through a passage 42. Air flow through the passage 41 is used to provided pressurised air to assist in atomising the liquid spray emitted from the nozzle 18. Air passing through the passage 42 passes through an air flow regulator 44. The output of the air flow regulator 44 is conveyed via a passage 46 to a turbine chamber 45. The turbine chamber 45 houses a rotatable turbine blade member 48, and air is ported from the passage 46 so as to directly impinge upon the turbine blade member 48. The turbine member 48 is a rotatable member having a plurality of blades positioned about its circumference so as to cause rotation of a shaft attached thereto in response to the impingement of pressurised air. The shaft attached to the turbine blade member 48 rotates an electrical generator 50 which generates a low voltage that is fed to a stepup transformer 52 and transformed into an intermediate high voltage. This intermediate high voltage is coupled into a cascade voltage multiplier (not shown) of the Cockroft-Walton type, which multiplier is housed in the barrel 16, and which has an output conductor electrically connected to the electrode 26. Alternatively, the output of the generator 50 may be connected into a further voltage oscillator circuit for generating a higher frequency signal, which signal is then transformed through a transformer and coupled into a cascade voltage multiplier circuit. In any event, the mechanical linkage to the turbine blade member 48 is coupled to drive suitable electrical components for providing the necessary high voltage. The rotating components associated with this drive concept generate mechanical heat, and the electrical components associated with the voltage generating and transforming circuits generate considerable electrical heat. The primary generating members are all located within the body 14, and it is desirable to provide a heat dissipating mechanism within the spray gun to protect and cool these components.

The pressurised air which is utilized to rotate the turbine blade member 48 is exhausted from the turbine chamber 45 into an exhaust chamber 54. The exhaust chamber 54 is sized so as to provide unrestricted air flow about all of the mechanical and electrical components in the body 14. A passage 58 is coupled in flow communication with the exhaust chamber 54 and the passage 58 is coupled to an exhaust passage 60 in the handle 12 of the spray gun. The exhaust passage 60 opens to the atmosphere through an opening 61, thereby to release the exhaust air downwards in a direction away from the liquid particles emitted from the nozzle 18.

Figure 2 shows the air flow regulator 44 in greater detail. The flow of air is in the direction of the arrow passing from the passage 42 into the air flow regulator 44 and therethrough. Figure 3 shows the air flow regulator 44 under conditions of excess pressure operation, whereas Figure 2 shows the air flow regulator 44 under conditions of normal pressure operation. The air flow regulator 44 is a resilient O-ring having special design characteristics. The air flow regulator may be selected from products manufactured for that purpose by Vernay Laboratories, Inc., Yellow Springs, Ohio, U.S.A., as for example the Vernay product designated as Model VA-3636, which has been found to be adequate and useful for the intended purpose in connection with this invention. Under circumstances of normal pressure, the air flow regulator 44 provides a smooth opening through which pressurised air may flow. If pressure builds up beyond the predetermined limit it causes deformation of the resilient material of which the air flow regulator 44 is constructed, as is shown in Figure 3. This deformation results in an overall reduction in the cross-sectional flow area through the air flow regulator 44, and restricts the rate of flow of air therethrough. Materials may be selected which provide a relatively constant air flow rate over wide pressure variations, as for example, a plus or minus 10% flow rate variation over pressures ranging from 14000 to 70000 kg/m^2 (20 to 100 psi). Control over this air flow rate is extremely important for it is the rate of air flow which determines the speed of rotation of the turbine blade member 48. Unrestricted air flow into the turbine chamber 45 could cause wide variations in rotational speed of the turbine blade member 48, and consequent wide swings in the amount of heat generated by the mechanical and electrical components which are connected to the turbine blade member 48.

In operation, a source of pressurized air is connected to the connector 28, and a source of pressurised liquid is connected to the connector 20. When the trigger 24 is depressed it causes the pressurised air to flow into the various internal passages of the spray gun, some of which may be directed toward the front of the spray gun to assist in the atomisation of the emitted particles of liquid. A portion of the internal air is delivered through the air flow regulator 44 under controlled flow rate conditions to rotate the turbine blade member 48 at a relatively constant rate. This causes the electrical generating members

to supply a relatively constant voltage which is multiplied *via* the cascade multiplier to generate a fairly constant high voltage at the electrode 26. After the air has been utilized in the turbine chamber for purposes of rotating the turbine blade member, it is exhausted through the exhaust chamber 54 which surrounds the electrical and mechanical components in the body of the spray gun. The air passing over these components dissipates heat generated therein, and conveys this excess heat into the exhaust passage 60 in the handle. Finally, air is exhausted from the bottom of the handle in a downward and rearward direction, whereby the emission is directed away from the operator with a result of reduction in audible noise. Further, the circuitous path of the air flow as it is directed through the internal passages tends to muffle air flow sound and to reduce the overall sound emitted from the opening 61. Still further, since the exhaust air is directed downwardly and rearwardly, it does not disturb the pattern of particles of liquid being emitted from the nozzle 18. All these factors serve to increase greatly the reliability and convenience of operation of the spray gun, and to provide operating conditions to enable a fine quality of spray to be developed and emitted from the nozzle of the spray gun.

CLAIMS

1. An electrostatic spray gun comprising: an internal air turbine mechanically linked to a rotatable electrical generator; an air coupler attached to said gun for receiving pressurised air; electric circuitry coupled to said generator for developing high voltage in response to the pressurised air delivered to the turbine; an internal passsage passing between said air coupler and said turbine; an external actuable air valve in said passage for opening and closing said internal passage; an air flow regulator in said internal passage; an exhaust chamber at least partially surrounding said generator and said circuitry and coupled in air flow connection to said turbine; and an exhaust passage connected to said exhaust chamber and opening to the exterior.

2. A spray gun as claimed in claim 1 including a body having a handle and a barrel attached thereto, said air coupler being attached to said handle.

3. A spray gun as claimed in claim 2 in which said internal passage includes a passageway through said handle, said air valve being located in the passageway.

4. A spray gun as claimed 2 or 3 in which said turbine and generator are contained in said body, said exhaust chamber comprising a cavity in said body substantially surrounding said turbine and said generator.

5. A spray gun as claimed in claim 4 in which said exhaust passage includes a pasageway through said handle, connected at one of its ends to said exhaust chamber and opening through the handle at its other end.

6. A spray gun as claimed in any preceding claim in which said air flow regulator comprises a resilient O-ring in said internal passage, said O-ring being deformable to constrict an opening therethrough under the influence of predetermined excess air pressure.

7. An electrostatic spray gun comprising a barrel for emitting particles and having an electrode projecting therefrom; a handle; a body attached to said barrel and said handle, said body having a pivotal trigger attached thereto and enclosing an air turbine and electrical generator; an air connector attached to said handle and a first passage in said handle coupled to said air connector and extending into said body; a second passage in said body coupling between said first passage and said air turbine in air flow relationship; an air flow regulator in said second passage; a cavity in said body about said air turbine and said generator, said cavity being in air flow coupling relationship to said air turbine; a third passage coupled between said cavity and said handle, said third passage passing through said handle and opening to the exterior.

8. A spray gun as claimed in claim 7 including a valve in said first passage having an actuator stem passing through said handle to an actuating position proximate said trigger.

9. A spray gun as claimed in claim 7 or 8 in which said air flow regulator comprises a deformable ring in said second passage.

10. A spray gun as claimed in any of claims 7 to 9 in which said first and third passages are substantially parallel over at least a portion of their respective lengths in said handle.

11. An electronic spray gun substantially as herein described with reference to and as shown in the accompanying drawings.

12. Any novel integer or step, or combination of integers or steps, hereinbefore described and/or as shown in the accompanying drawings, irrespective of whether the present claim is within the scope of, or relates to the same or a different invention from that of, the preceding claims.

Printed in the UK for HMSO, D8818935, 11 84, 7102.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.